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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

GUERRERO, MARIA F

ART UNIT PAPER NUMBER

2822

DATE MAILED: 05/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/765,437

Applicant(s)

SUZUKI, TOSHIYA

Examiner

Maria Guerrero

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 February 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3, 5-16 and 18-26 is/are pending in the application.
- 4a) Of the above claim(s) 7, 14 and 21 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3, 5, 6, 8-13, 15, 16, 18-20 and 22-26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

1. This Office Action is in response to the Request for continued Examination and the Amendment filed February 21, 2003.

Claim 4 and 17 are canceled.

Claims 1-3, 5-16, and 18-26 are pending.

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on February 21, 2003 has been entered.

Election/Restrictions

3. Claims 7, 14, and 21 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 6.

Applicant's election without traverse of Group II, claims 1-6, 8-13, and 15-20 in Paper No. 6 is acknowledged.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 8 and 10-11 are rejected under 35 U.S.C. 102(b) as being anticipated by Yamamichi et al. (U.S. 5,530,279).

Yamamichi et al. teaches forming a lower electrode above a semiconductor substrate (101, 301) having semiconductor elements (Fig. 1, 3A-3B, col. 3, lines 37-55). Yamamichi et al. discloses the lower electrode (104, 304) having a top surface and side surfaces (3B). Yamamichi et al. teaches forming a dielectric film (105, 305) on a surface of the lower electrode, the dielectric film being thicker in a region near a boundary between the top surface and each of the side surfaces than in a lower region of the side surfaces (Fig. 3C, col. 3, lines 45-50, col. 4, lines 30-37). Yamamichi et al. discloses forming an upper electrode (106, 306) on the dielectric film (Fig. 3D, col. 4, lines 44-48). Yamamichi et al. discloses forming a film with good and poor coverage (Fig. 3C). Yamamichi et al. discloses forming the dielectric film by physical vapor deposition (col. 3, lines 45-50, col. 4, lines 30-35).

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5. Claims 15-16 are rejected under 35 U.S.C. 102(e) as being anticipated by Lee (U.S. 6,077,450).

Lee teaches forming a rare metal layer above a semiconductor substrate formed with semiconductor elements, forming an insulating mask layer (silicon oxide) on the rare metal layer, patterning the rare metal layer by using the patterned insulating mask layer (col. 3, lines 10-15, 20-28). Lee teaches forming a metal nitride layer on the rare metal layer (Fig. 3a, col. 3, lines 5-12). Lee teaches terminated patterning the insulating mask before the rare metal layer is exposed and patterning the metal nitride and the rare metal layer by using the patterned insulating mask layer (Fig. 3b-3d, col. 3, lines 10-35).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1-3, 5, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saenger et al. (U.S. 5,633,781) in view of Alers (U.S. 6,303,426).

Saenger et al. teaches forming a first insulating film on a semiconductor substrate formed with semiconductor elements, forming a contact hole through the first insulating film, forming a conductive plug (tungsten), and heating the semiconductor substrate in a nitriding atmosphere to nitride the plug (col. 3, lines 55-67, col. 4, lines 5-55). Saenger et al. teaches forming an etch stopper layer on the first insulating film, the etch stopper

covering the plug (col. 6, lines 27-50). Saenger et al. teaches forming a silicon nitride layer by CVD (col. 4, lines 1015, 27-29). Saenger et al. discloses forming a second insulating film on the silicon nitride layer, forming an opening through the second insulating film, the opening reaching the surface of the plug, forming a rare metal layer in the opening (Fig. 10-15, col. 6, lines 20-65). Saenger et al. shows forming a lower electrode (rare metal) above a semiconductor substrate formed with semiconductor elements, forming a dielectric film on a surface of the lower electrode by CVD, and forming an upper electrode (col. 4, lines 10-65, col. 5, lines 50-60).

Saenger et al. does not specifically show the etch stop layer having the function of stopping etching the second insulating film. However, Saenger et al. teaches the etch stop layer 52 functions as an etch stop layer when etching vertical portion 16 (Fig. 10-12, col. 6, lines 27-45).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to recognize that the etch stop layer taught by Saenger et al. would function as etch stop layer with relation to the second insulating film in order to protect the plug (col. 6, lines 39-42).

Saenger et al. does not specifically show heating the semiconductor substrate in a nitriding atmosphere to nitride the plug. Saenger et al. does not specifically show the nitriding process in an atmosphere containing ammonia and being executed at a temperature of 600 ° C to 850 ° C. Saenger et al. does not specifically show the etch stop material being TaO or TiO. However, Alers discloses nitridizing a tungsten plug using ammonia and at 700 ° C (col. 1, lines 55-65, col. 3, lines 20-40). Alers also

teaches forming a TaO or TiO layer over the structure in order to protect the plug (Fig. 3, col. 3, lines 50-60).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Saenger et al. reference by including the information provided by Alers in order to avoid oxidation on the surface of the bottom electrode and improve adhesion (Alers, col. 1, lines 25-30, 43-47).

7. Claims 6 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saenger et al. (U.S. 5,633,781) and Alers (U.S. 6,303,426) as applied to claims 1-3, 5 and 22 above, and further in view of Applicant admitted prior art.

Regarding claims 6 and 23, the combination of Saenger et al. and Alers fails to show forming the rare metal layer first through physical vapor deposition and then through CVD using oxygen. However, Applicant admitted prior art shows forming the rare metal layer by sputtering (physical vapor deposition) followed by a CVD process using oxygen (pages 1-3).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to include the formation of the rare metal layer by physical vapor deposition followed by the CVD process as taught Applicant admitted prior art because Saenger et al. is using the same rare metal as show Applicant admitted prior art. The modification would provide a capacitor, which would allow good connection between the capacitor and the semiconductor elements in the substrate (Saenger et al., col. 2, lines 15-18).

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8. Claims 9, 12-13, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamichi et al. (U.S. 5,530,279) in view of Applicant admitted prior art.

Regarding claim 24, Yamamichi et al. does not specifically show the dielectric layer being 60% or more thick than the thickness at the side surfaces. However, Yamamichi et al. shows that the thickness can be controlled during the film formation and the selection of any appropriated thickness would be obvious (Fig. 3C, col. 4, lines 30-45).

Regarding claims 9 and 12-13, Yamamichi et al. fails to show forming the rare metal layer first through physical vapor deposition and then through CVD using oxygen, the lower electrode having a cylinder shape. However, Applicant admitted prior art shows forming the rare metal layer by sputtering (physical vapor deposition) followed by a CVD process using oxygen. Applicant admitted prior art teaches the lower electrode having a cylinder shape as conventional in the art (pages 1-3).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to include the formation of the rare metal layer by physical vapor deposition followed by the CVD process and using the lower electrode having cylinder shape as taught Applicant admitted prior art because Yamamichi et al. is using the same rare metal as show Applicant admitted prior art. The modification would provide a capacitor having a reduced leakage current.

9. Claims 18-20 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee (U.S. 6,077,450) in view of Joo (U.S. 6,342,425).

10. Regarding claim 18, Lee does not specifically show using hydrogen-containing gas or hydrogen atmosphere to form the metal nitride layer.

Regarding claims 19-20 and 26, Lee does not specifically show forming a dielectric film on the patterned lower electrode, forming a silicon oxide film by TEOS based CVD, and annealing the semiconductor substrate in hydrogen-containing gas. However, Joo discloses forming a dielectric film on the patterned lower electrode (Fig. 3D, col. 4, lines 20-25). Joo teaches forming a silicon oxide film by TEOS based CVD, and annealing the semiconductor substrate in hydrogen-containing gas (the thermal process inherently discloses this step) (col. 4, lines 60-67, col. 5, lines 1-5).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Lee's process by including the information provided by Joo. The modification would provide a process for forming a capacitor without damaging the structure during patterning.

11. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee (U.S. 6,077,450) in view of Joo (U.S. 6,342,425) and Hasegawa et al. (U.S. 6,452,274).

Lee teaches forming a rare metal layer above a semiconductor substrate formed with semiconductor elements, forming an insulating mask layer (silicon oxide) on the rare metal layer, patterning the rare metal layer by using the patterned insulating mask layer (col. 3, lines 10-15, 20-28). Lee teaches forming a metal nitride layer on the rare metal layer (Fig. 3a, col. 3, lines 5-12). Lee teaches terminated patterning the insulating

mask before the rare metal layer is exposed and patterning the metal nitride and the rare metal layer by using the patterned insulating mask layer (Fig. 3b-3d, col. 3, lines 10-35).

Regarding claim 25, Lee does not specifically show forming a dielectric film over the semiconductor substrate, the insulating mask being a TaO layer. However, Joo discloses forming a dielectric film over the semiconductor substrate (Fig. 3D, col. 4, lines 20-25). Hasegawa et al. shows TaO being used instead of silicon oxide as a mask as conventional in the art (col. 21, lines 1-8).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Lee reference by including the information provided by Joo and Hasegawa et al. The modification would provide a process for forming a capacitor without damaging the structure during patterning and having an increased etch selectivity.

Response to Arguments

12. Applicant's arguments with respect to claims 1-3, 5-6, 15-16, and 18-26 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Shen et al. (U.S. 6,420,272) and Nam et al. (U.S. 6,054,391)


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teaches silicon oxide, silicon nitride, titanium, titanium oxide, and titanium nitride are typical mask materials used for patterning platinum (col. 2, lines 15-27).

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maria Guerrero whose telephone number is 703-305-0162.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 703-308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


Maria Guerrero
Patent Examiner
April 30, 2003